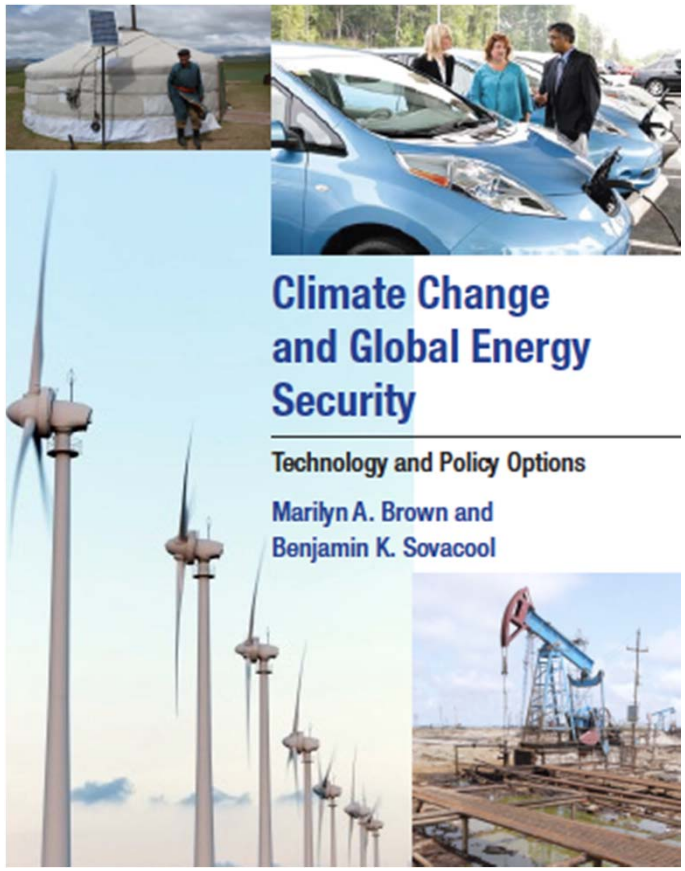
Emergence of Policies to Promote Smart Grid Urban Infrastructure



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Georgia Institute of Technology

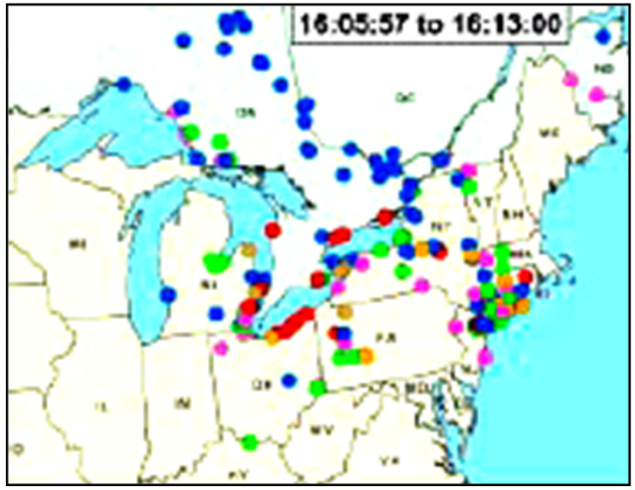
China-US Workshop on Environmental Protection
and Urban Sustainable Development
Tianjin University
June 14-16, 2012

CLIMATE AND ENERGY POLICY LABORATORY
SCHOOL OF PUBLIC POLICY

"Why should I worry when the grid is better than 99% reliable?"

2009 U.S. electricity consumption:	**3,741 Billion kW-h** *(EIA)*
Estimated annual outage costs:	**$ 30 Billion - $ 130 Billion** *(LBNL report to OE, 2004)*

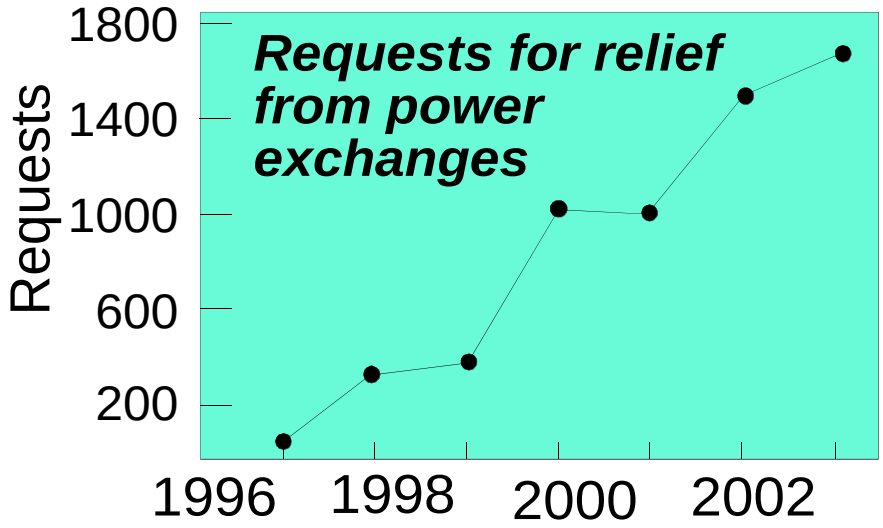
2003 Northeast Blackout



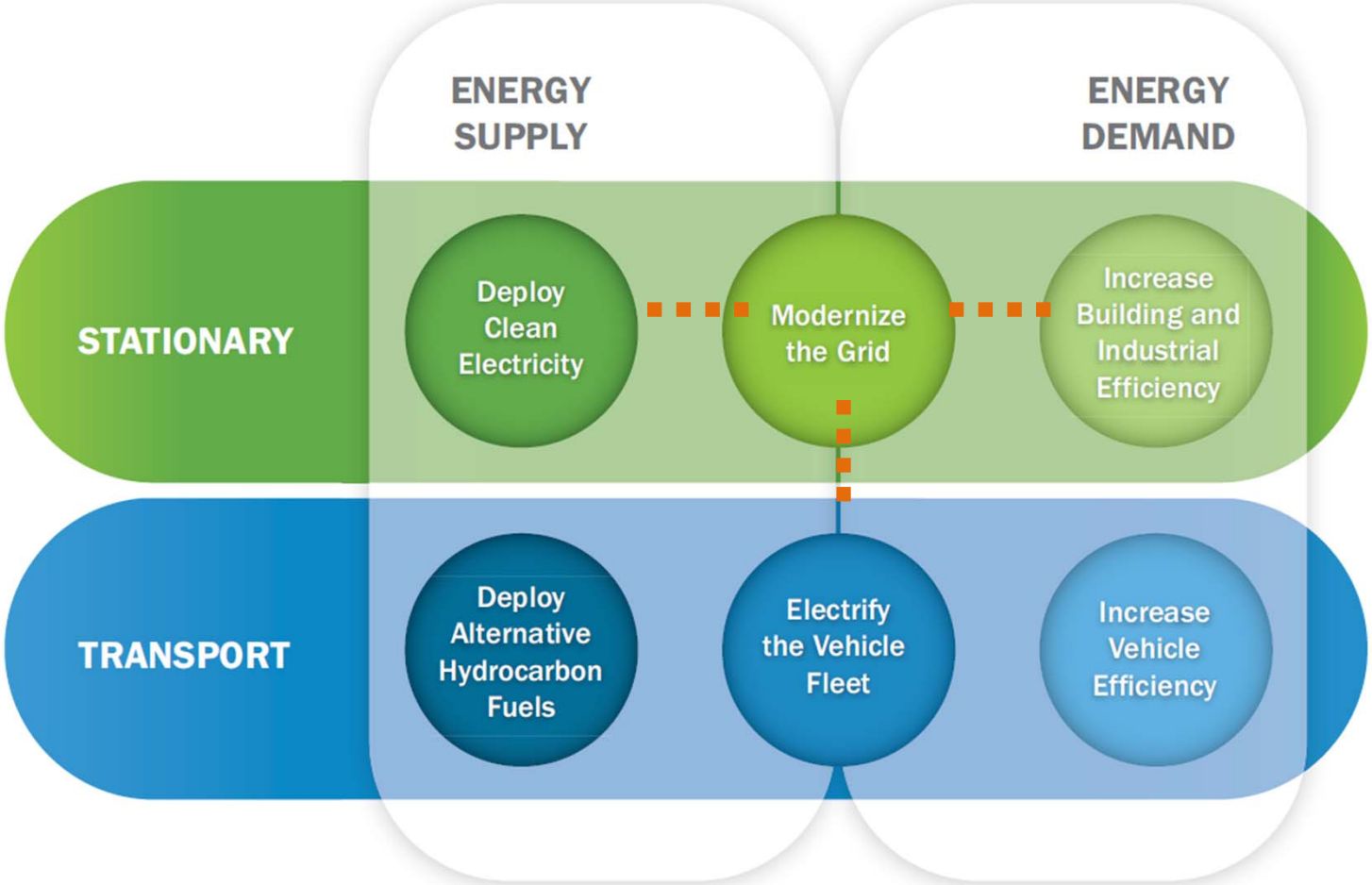
- 508 generators tripped
- Cleveland → Toronto → NYC
- 7 minutes

Report on 2003 North American Blackout, North American Electric Reliability Council

Grid congestion



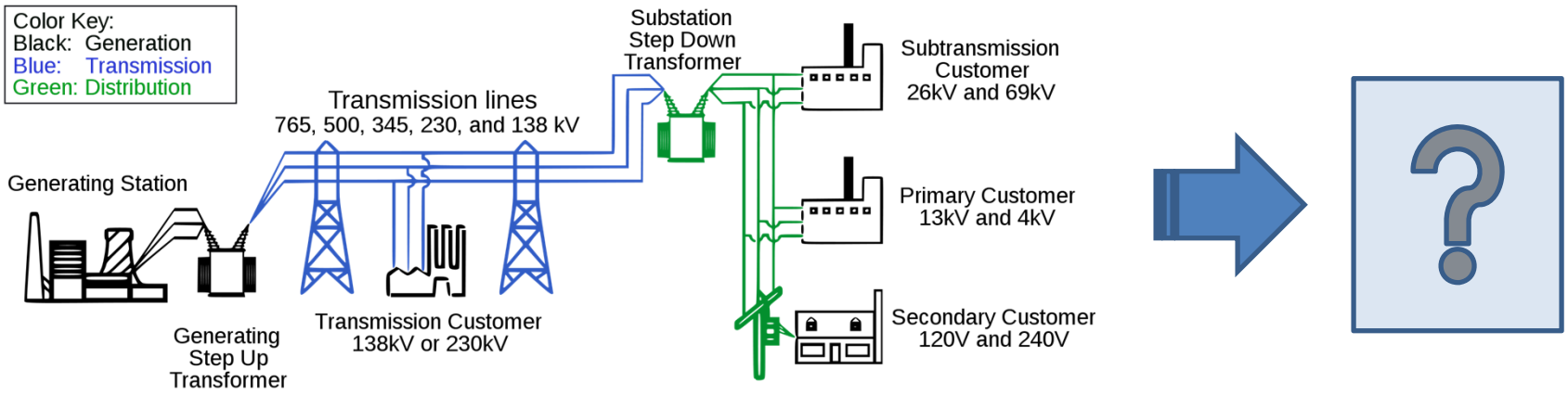
The Grid connects and touches many parts of the energy system



We cannot accept the mantra "changing the Grid is not possible because it is too complex" – it is too important to ignore

The Future Grid

what should it look like?



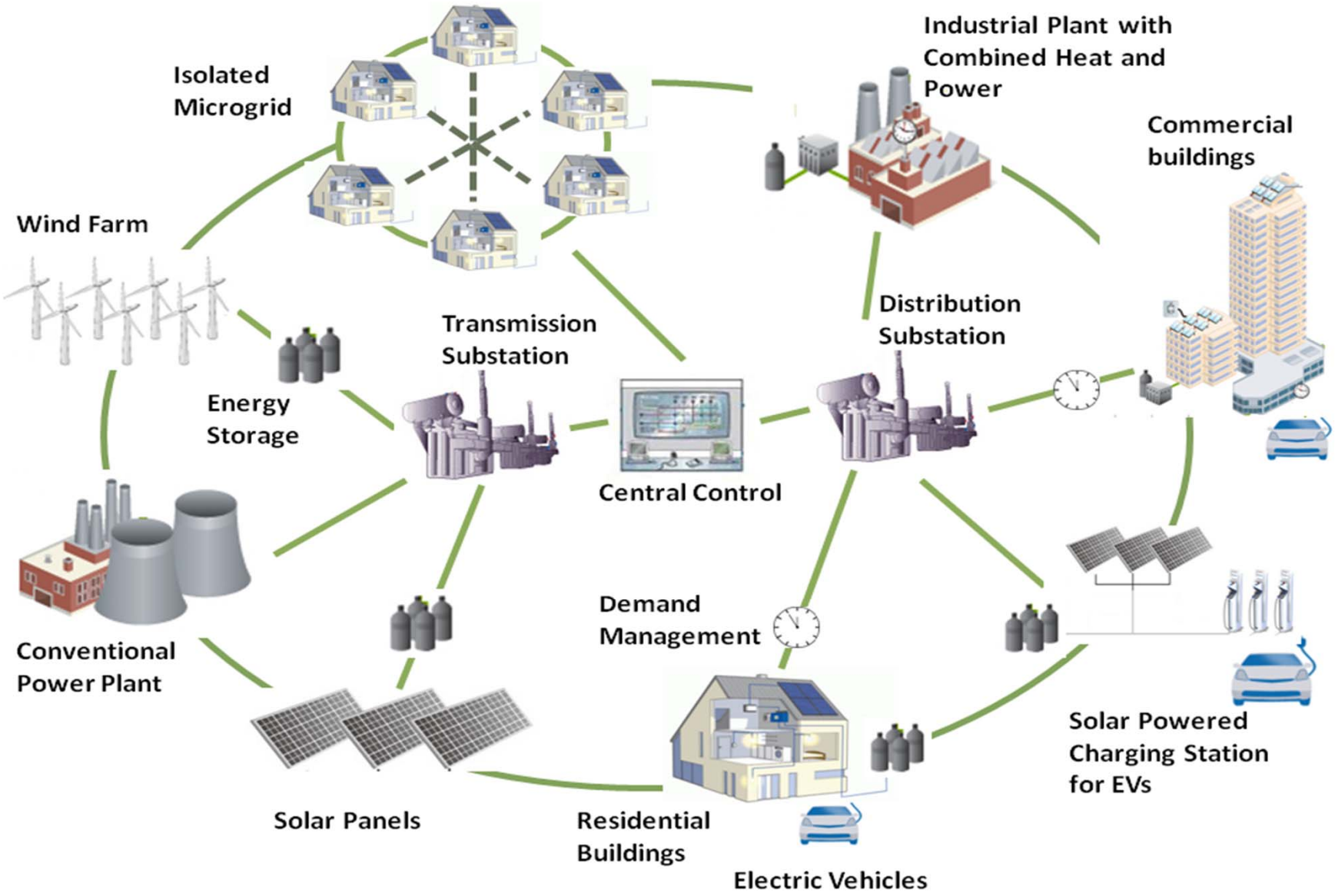
It should be capable of:

- Enabling informed participation of customers
- Accommodating all generation and storage options
- Providing the power quality for a range of needs
- Optimizing asset utilization and operating efficiency
- Providing resiliency to disturbances, attacks, and natural disasters

How do we get there?

- Planning, policy and other non-technical support (e.g., markets, regulations, environmental considerations)
- Analysis, standards and model development
- System integration and distributed technologies
- Grid energy storage and demand response
- Grid components and materials innovations

Smart Grid: A Vision for the Future



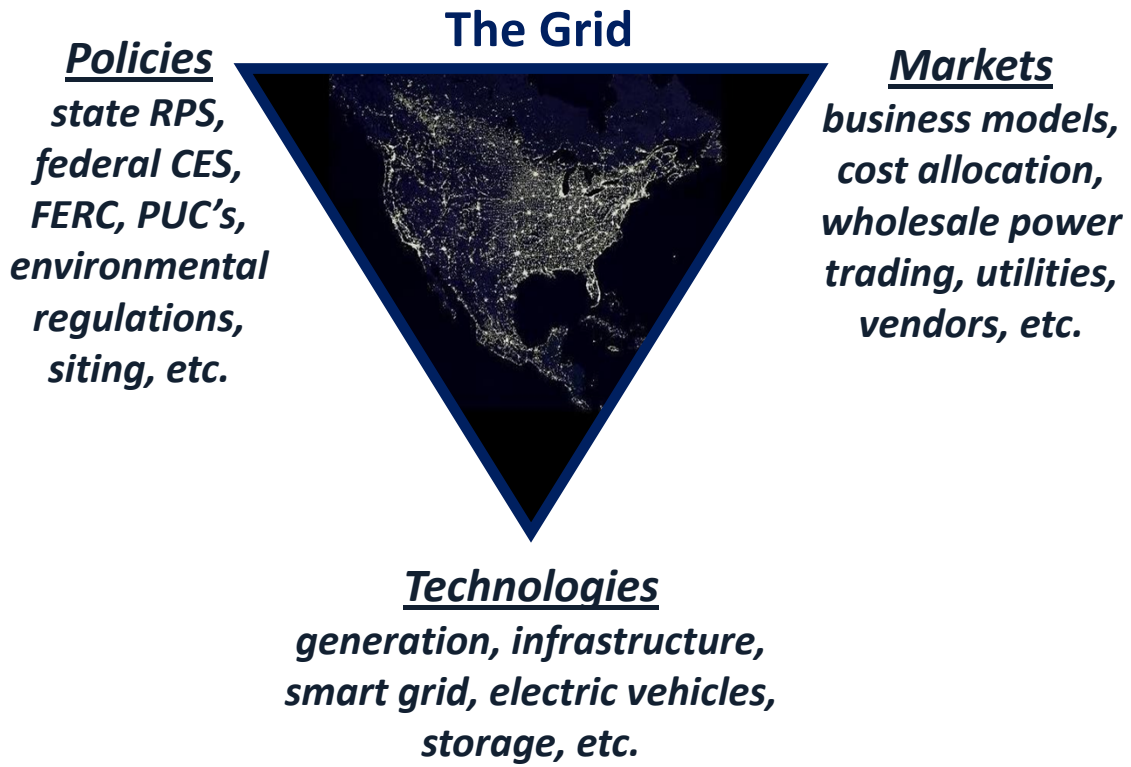
Source: Brown, M. A. and S. Zhou (Forthcoming). The Emergence of Smart-Grid Policies. In R. A. Meyers (Ed.), *Encyclopedia of Sustainability Science and Technology. Springer Science + Business Media, LLC.*

Changes to the Grid require an intricate balance of technologies, markets, and policies

U.S. Department of Energy's Clean Energy Goals:

- By 2035, 80% of America's electricity will come from clean energy sources
- By 2020, 20% improvement in the energy efficiency of commercial buildings relative to 2010
- Put 1 million electric vehicles on the road by 2015
- Energy-related GHG emissions will reduce 17% by 2020 and 83% by 2050

- ***Policies drive markets which drive technologies***

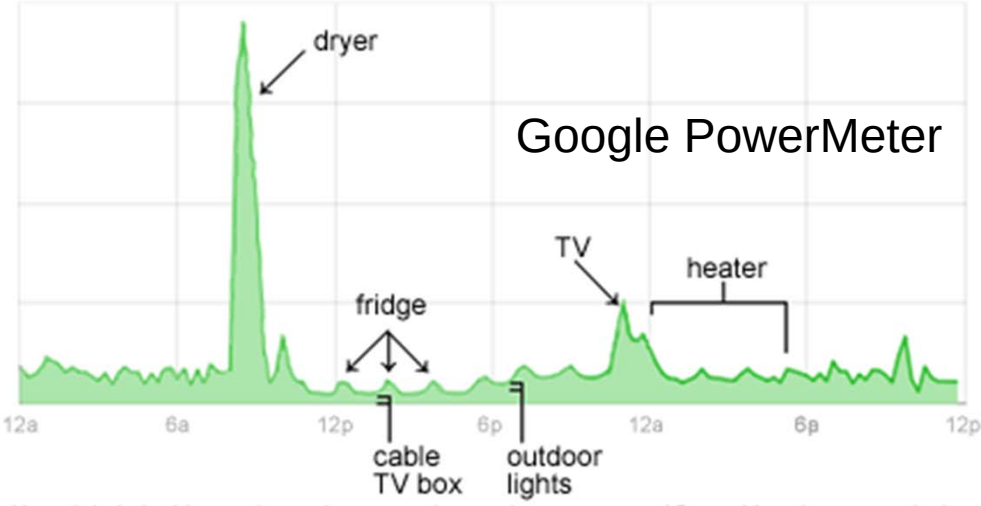


Technologies – Smart Meters & Displays

- Meter that allows frequent data collection
- Enables alternative pricing
- Can interface with in-home or in-office displays of online consumption information
- NOT just an automatic meter reader

ZigBee Rate saver

Energy Orbs that signal expensive & inexpensive times to use energy

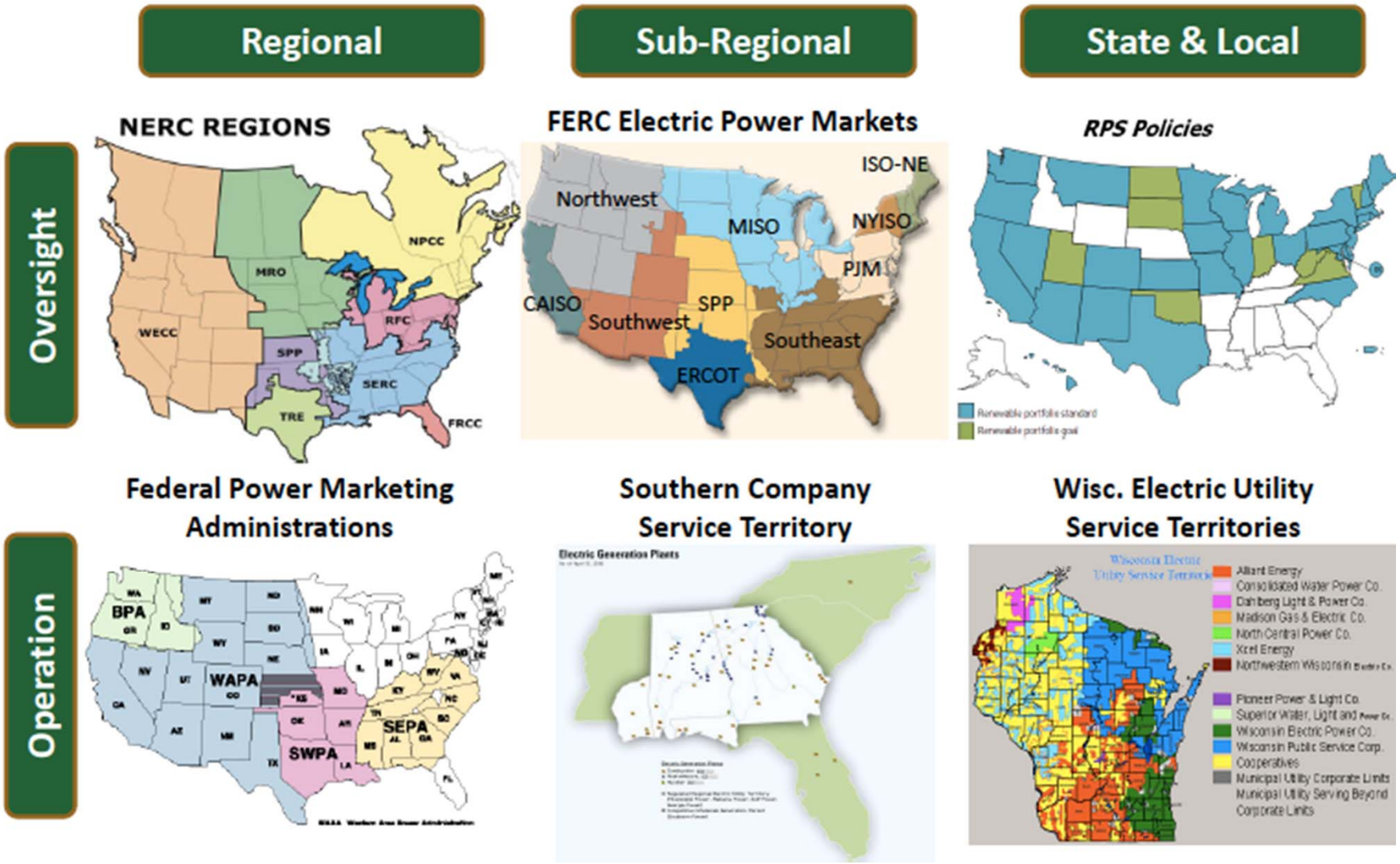


Google PowerMeter

Georgia Institute of Technology

Strategic Energy Institute

Markets – Complex of grid regulators and stakeholders in the U.S.



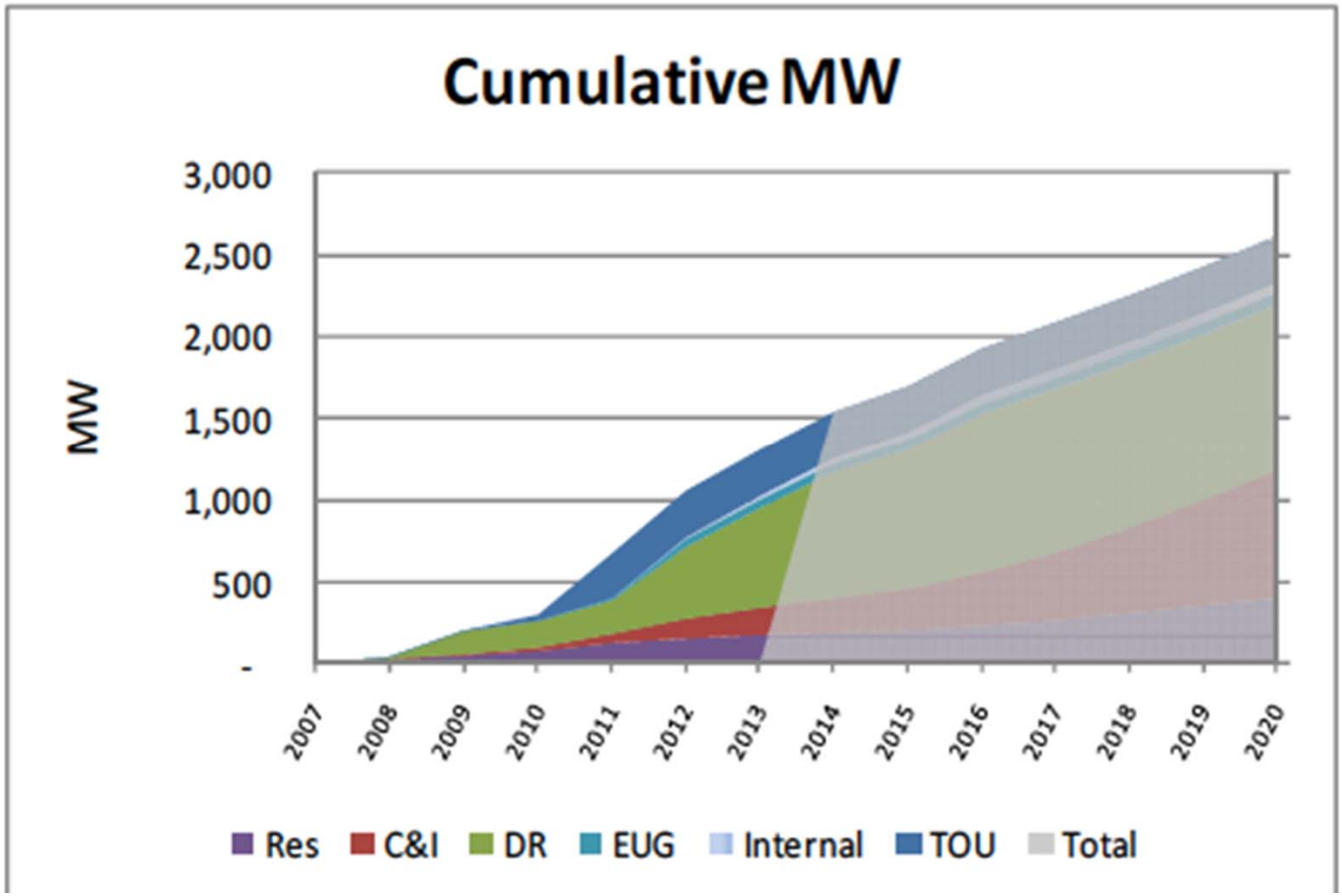
Source: DOE Quadrennial Technology Review. 2011. www.energy.gov/QTR

Policies – Shaping the Smart Grid

- Net Metering Policies
- Interconnection Standards and Rules
- Dynamic Pricing and Demand Response
  - Time-of-Use Pricing (TOU)
  - Critical Peak Pricing (CPP)
  - Real-Time Pricing (RTP)
- Smart Metering Targets
- Renewable Energy Subsidies & Regulation
- Smart-Grid Demonstration Projects
- International Smart-Grid Collaboration

Public-Private Partnerships (e.g., Tennessee Valley Authority & EnerNOC)

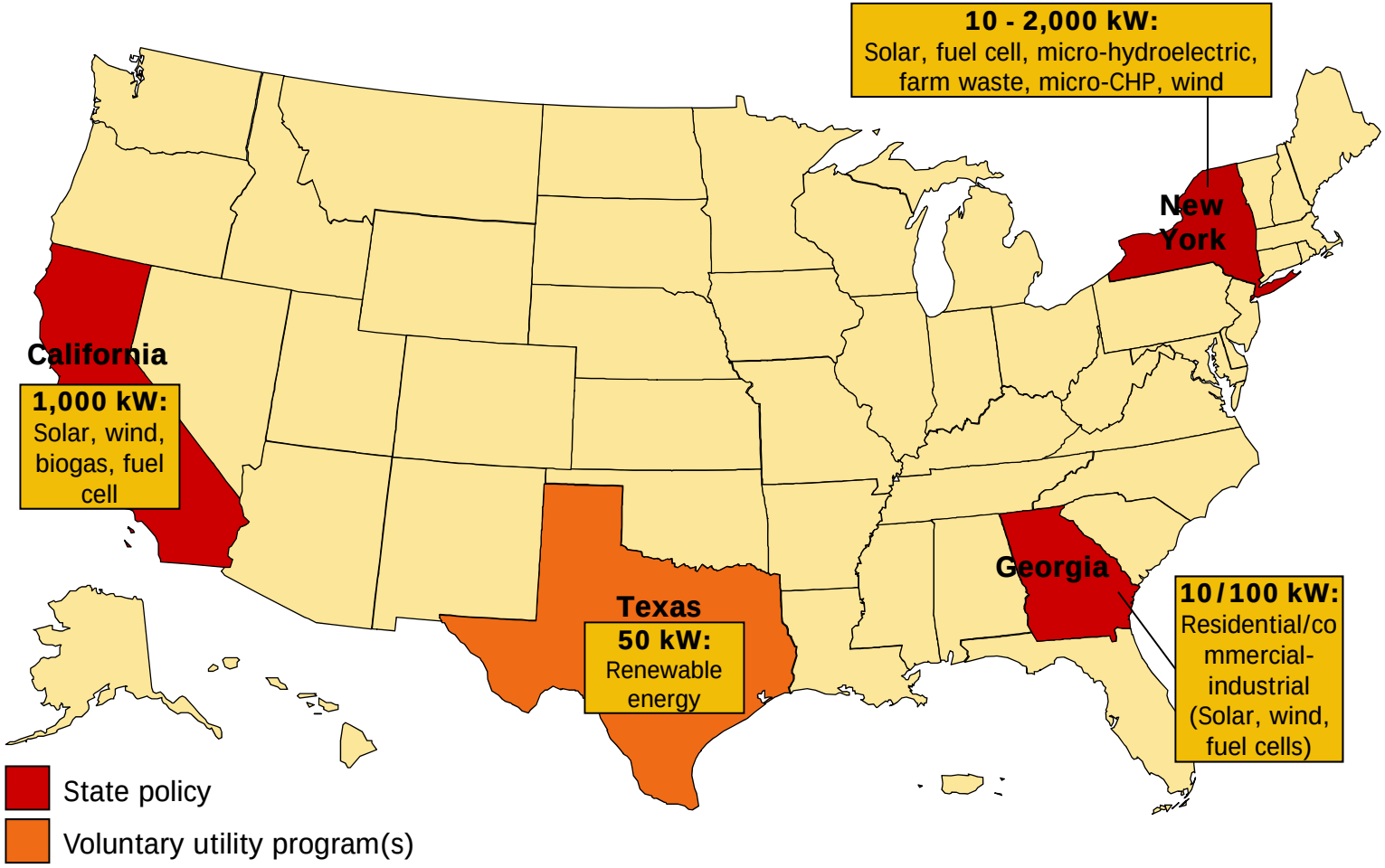
TVA Energy Efficiency and Demand Response
(Cumulative Electricity Savings)



Smart-Grid Policies: Barriers and Drivers

	Barriers					Drivers				
Smart-Grid Policies	High Costs	Technical Risks	Regulation and Monopoly Structure	Incomplete & Imperfect Information	Privacy & Security	Increasing Electricity Demand	Rising Energy Prices & Reliability Concerns	Climate Change & Clean Air	Deployment of Renewable Power& Electric Vehicles	Economic Development and Business Opportunity
Net Metering	×	×	×			×	×	×	×	×
Interconnection Standards and Rules	×	×	×	×	×	×	×	×	×	×
Dynamic Pricing	×		×	×		×	×		×	
Smart Metering Targets			×	×		×	×	×	×	×
Renewable Energy Subsidies & Regulations	×	×	×			×	×	×	×	×
International Smart-Grid Collaboration	×	×		×		×	×	×	×	
Smart-Grid Demonstration Projects		×		×		×	×	×	×	×

Net Metering Policies in Four US States: Capacity Limits of Qualifying Facilities



(Source: revised from DSIRE's map, http://www.dsireusa.org/summarymaps)

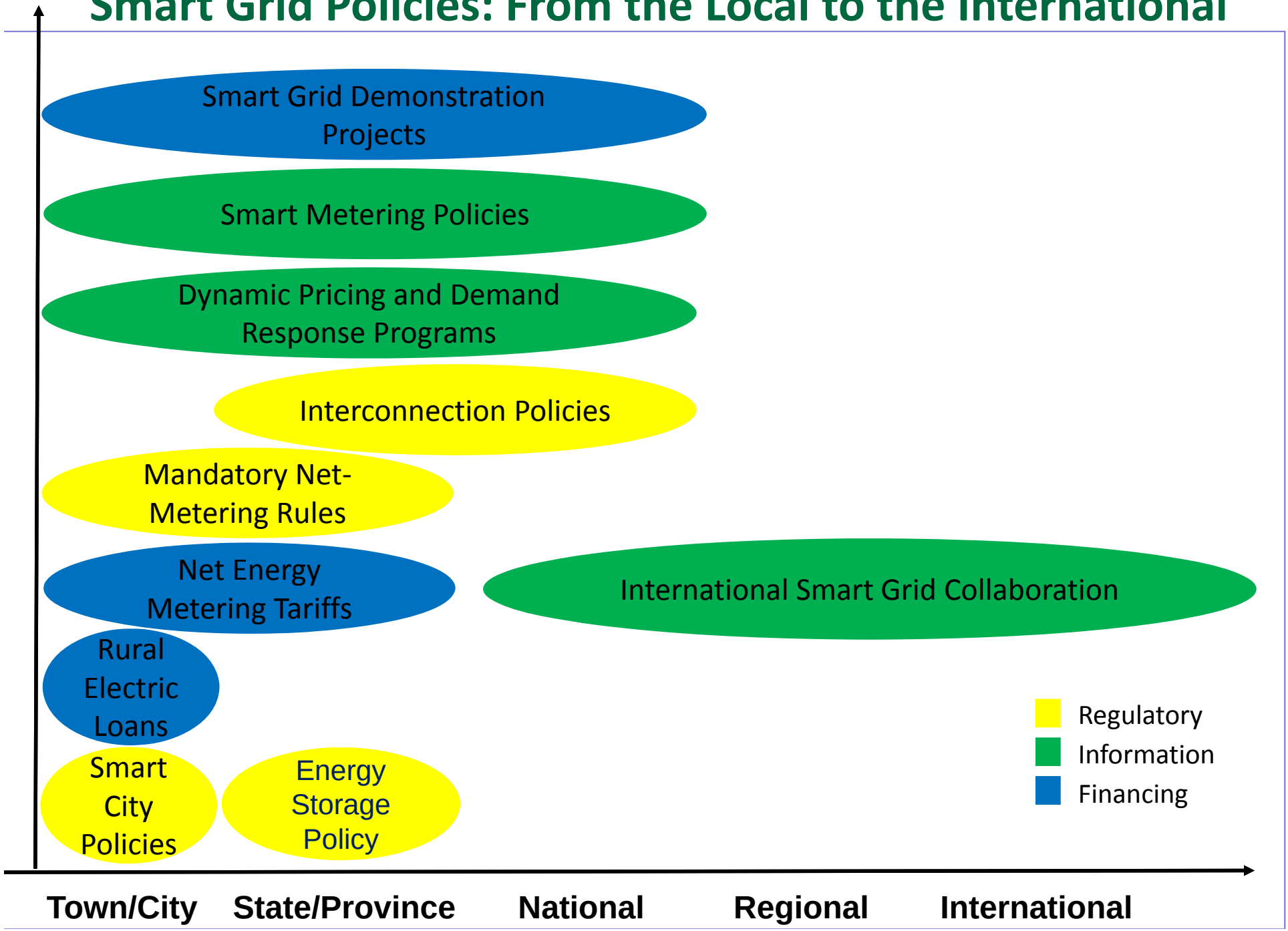
Dynamic Pricing Policies in Four US States

	Types of Rates	Targeting Systems			
		Residential Sector	Commercial and Industrial Sectors	Agricultural Sector	Electric Vehicles
CA	Critical Peak Pricing	√	√	√	
	Real-Time Pricing		√	√	
	Time-of-Use	√	√	√	√
TX	Time-of-Use	√			
GA	Time-of-Use	√	√	√	√
	Real Time Pricing		√		
NY	Real Time Pricing		√		

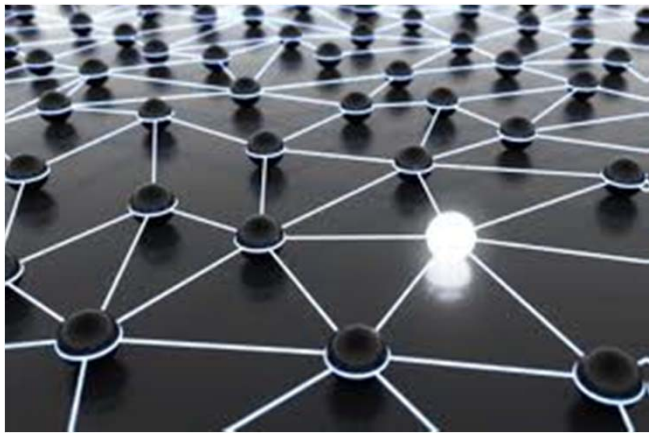
National Targets and Policy Drivers

	Targets		Policy Drivers
	Carbon Emissions	**Renewable Energy (% of total primary energy supply)**	
USA	17% below 2005 level by 2020	Vary across states: CA — 33% by 2020 TX — 5880 MW by 2020 NY — 29% by 2015 GA — no target	- Technical and operational standards - Smart meters - Dynamic pricing and demand response
EU	20% below 1990 level by 2020	20% by 2020	- Technical and operational standards - Smart meters
Japan	30% below 1990 level by 2030	13% by 2030	- Smart community - Smart meters - Solar PV
Korea	30% below BAU by 2020	11% by 2030	Smart power grid - Smart transportation - Smart renewables - Smart electricity services
China	17% below 2011 level by 2015 (Carbon Intensity)	11.4% by 2015	- Ultra High Voltage (UHV) regional transmission - Upgrading and modernizing urban and rural electric grid

Smart Grid Policies: From the Local to the International



Recommended Policy Directions for the U.S. Smart Grid



- A policy framework that attracts diverse funding sources for smart-grid deployment
- Regulatory changes that promote competitive electricity markets
- Policy making that takes into account societal cost-benefit analysis and consumer behavior

Thank You!
谢谢 ！